Prof. Carmichael
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RICHMOND SCHOOL OF MEDICINE.

MEDICAL EDUCATION.

(7.)

AN ESSAY

ON

MEDICAL EDUCATION,

BEING AN

INTRODUCTORY LECTURE

DELIVERED AT

THE RICHMOND SCHOOL OF MEDICINE, DUBLIN.

BY

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ERRATA.

In page 30, line 10, for *would remain at about* 99°, read *would remain at about* 98°.

The following Lecture was written without the least anticipation that it would at any time be printed. It has been published in deference to the advice of several friends, in whose judgment I have confidence, and who have expressed to me a much higher opinion of its probable utility, than I had myself ventured to entertain. A majority of the class of Students to which it is addressed are in a situation precisely similar to that of a traveller entering a country with which he is altogether unacquainted. A rapid sketch of the principal objects of interest—directing his observation and inquiries to those of real importance—and warning him of dangers to be shunned, would furnish him with information that he could hardly, at the commencement of his journey, prize too highly. It is hoped that this Lecture may serve a somewhat similar use in the hands of the young Medical Student. If it shall be found to answer this purpose, or to raise in any degree the standard of education amongst the Students of the Richmond School of Medicine—which I proposed to myself as a principal object in writing it—the end for which it was written and is published will be fully attained.

INTRODUCTORY LECTURE.

Gentlemen—Presuming, or rather knowing, that a considerable proportion of those present consists of young men who are just entering on their professional studies, I think I cannot more profitably employ the hour allotted to the discussion of topics introductory to the several courses of lectures to be delivered in this School, during the ensuing season, than by addressing myself especially to this portion of the class, with the view of giving some correct general notions respecting the sciences with which a well educated medical student should make himself acquainted. I shall endeavour to point out the relative importance of these sciences, the reasons of their importance, and their bearing on one another; and to communicate such advice concerning the mode of conducting a medical education, as, from a careful consideration of the subject, I am persuaded, would, if followed, materially contribute towards the successful issue of the student's exertions. The extent of the subject, which might afford matter for several lectures, as well as the consideration of the portion of the class I particularly address, renders it necessary for me to confine myself to the most striking and important points under each of the heads I have enumerated.

Greek. Very many scientific terms are derived from it, and besides, many of the classical authors, in various departments of the medical sciences, wrote originally in Latin, and of their writings, several of the best have never been translated into English. I allude particularly to the great store-house of physiological information, the "Elementa Physiologiæ" of Haller, a work of incredible labour, and which renders it almost superfluous to consult any book on the same subject written before his time; to the classical work of Sœmmering on Anatomy, "De Corporis Humani Fabrica"—and to the admirable treatise of Frank, on the treatment of diseases, "De Curandis Hominum Morbis." Many more might be mentioned, quite excellent in their kind, in different departments. It should be stated further, that although the practice of writing in Latin has fallen greatly into disuse, there are still, occasionally, first-rate essays published in that language, especially in Germany. I imagine very few persons could be found, now-a-days, to assert, that a knowledge of the French language is less essential to the medical student than that of Latin. In some of the medical sciences, the French philosophers of the present day excel those of all other countries, and in every department there are French writers of the highest respectability. The names of Cuvier and Blainville, in comparative anatomy—of Bichat, Portal, Boyer, and Cloquet, in descriptive anatomy—and of Lænnec, Andral, Cruveilhier, and Louis, in pathological anatomy, are, perhaps, the most distinguished of modern times in the sciences I have mentioned. In chemistry, since the deaths of Sir H. Davy, Wollaston and Tennant, Gay Lussac and Thenard have no equal except Berzelius; and as writers on surgery, practice of physic, forensic medicine, physiology, and botany, Boyer—Pinel and Rostan—Fo-

deré—Bichat, Magendie, Dutrochet, Edwards, (who though an Englishman, writes in French) and Adelon—and lastly, Jussieu, Mirbel, and, I may add, the Genevese professor Decandolle, are of the very highest class. These are men with whose names you will soon be familiar, and whose writings would abundantly reward the labour of learning the language in which they are written. Let me add, as a further inducement to the acquisition of French, that it affords a key to many excellent German works, which have been translated into French, but not into English. It is for this reason principally, viz. that most of the capital works in German have been translated into French, that I consider German much less essential to be known than French. You will in a short time know, that it is a sufficient recommendation of German to say, that it is the language of Sœmmering, Tiedemann, Blumenbach, Meckel, Rudolphi, Sprengel, and a host of others, who are known, wherever medical science is cultivated, as men who have been eminently successful both in extending the limits of our knowledge, and in elucidating and confirming what was already known. Such of you as have but lately escaped the drudgery of learning Greek and Latin, and have not yet commenced French, will, I have no doubt, hear with dismay, my recommendation to undertake the study of two new languages; but you may be assured, if you feel this alarm, that it arises from a misconception of the difficulty of learning a language for practical purposes, *i. e.* to put it to use. To gain such a knowledge of the languages I have mentioned, as will render accessible to you the works of the great men who have written in them, is certainly not a task of any considerable difficulty. If you propose to yourselves, besides this, to be able to understand the spoken language, this is a more

difficult matter; and lastly, if you have it in view, in addition to these objects, to be able to speak and write the languages yourselves, this is, indeed, with regard to any language, an undertaking of the greatest difficulty. Unfortunately, languages are taught in our schools with this last view only. The very difficult object aimed at, is almost in every instance missed—if gained, it would be, in a vast majority of instances, useless, and unused in the business of life. Of the thousands who attempt to learn to speak and write Latin, how small a proportion have occasion to speak or write it after leaving college!

In strongly recommending to you the study of the French language, I do not wish you to encounter any difficulty in acquiring it, the overcoming of which will not turn to great and certain profit in use. Such an acquaintance with it, as will enable you to translate it, is all that I insist upon as nearly indispensable; and you may be assured, that I do not greatly understate the difficulty of attaining to this, when I say, that I am persuaded, any one of moderate abilities, who entirely devoted himself to the study of French for one month, would in that time be able to read the French systems of anatomy, and, in two or three months more, would have acquired a tolerable facility in translating any of the ordinary writings on scientific subjects. The great copiousness of German, renders it much more difficult of acquisition than French. It is for this reason, together with the one already hinted at, that I have not more strongly urged the advantage derivable from an acquaintance with this language also. If I were required to enumerate the languages of which I have spoken, in what I consider the order of their importance to the medical student, I should place them as follows:—

French, Latin, German, and Greek. In what I have already said of these languages, I have had in view merely the direct benefit you would derive from a knowledge of them; but in forming our estimate of their value, it is not to be forgotten, that in the study of them, we are naturally led to the study of the most perfect models of composition, in every kind, with which they abound. This is not the place to enlarge upon the elegance of thought and expression, the cultivation of mind, and refinement of taste, which a familiarity with classical literature almost invariably bestows. That it does so is a fact, for which it would be easy to assign sufficient reasons, and which should afford a strong inducement, in addition to those I have already mentioned, to the study of the languages I have recommended.

The two sciences of Anatomy and Physiology, form the basis on which is raised the superstructure of the other strictly medical sciences, viz. Practice of Physic, Surgery and Midwifery, Morbid or Pathological Anatomy, Materia Medica, and Pharmacy, and Medical Jurisprudence. An extensive acquaintance with these sciences is indispensable, and since their importance is so obvious, as to appear evident on merely stating their objects, I shall not occupy much of your time in speaking of them. The remaining sciences with which you are either obliged, or ought to make yourselves acquainted, are Chemistry, Botany, Natural Philosophy, and Comparative Anatomy. These are not strictly medical. We shall call them accessary or auxiliary sciences, and because the importance of the two last to the medical student is not evident, nor even generally admitted, I shall be at some pains to point out clearly the grounds of their utility.

You will perceive that I make no distinction between the purely medical and the surgical student. The dis-

tinction is a mischievous one, invented by ignorant, and continued by narrow-minded men. With the exception of skill in operation, there is no part of surgical knowledge which the physician ought not anxiously to seek, and it is no less incumbent on the surgeon to possess himself of whatever knowledge is more especially necessary in the practice of medicine. The distinction, however, between the medical and surgical practitioner is no less advantageous than the other is mischievous—advantageous, both as regards the interests of the public, and the progress of improvement in the different branches of our profession.

Anatomy is the science which teaches the structure of the human body. It requires little reflection to see, that a knowledge of it is of paramount importance; and that without it, no single step can be rationally taken towards the removal of disease. For, let us suppose a patient to present himself, who complains of certain symptoms, which he refers to a particular part of the abdomen. Would any sane man undertake to remove them, without knowing whether they were seated in the stomach, the liver, the kidney, one of the great blood-vessels, or in some other of the important parts contained in that cavity? If a surgical operation were required, the case is still plainer. Hence, you must devote yourselves, with the most patient assiduity, to the study of anatomy, and for the better mastering of the subject study it under different points of view, as, Descriptive Anatomy, Relative or Surgical Anatomy, and General Anatomy. To make these terms intelligible, I must explain in a few words what anatomists mean by *a system*. The human body consists of a variety of different kinds of substances, as bone, muscle or flesh, the nervous matter, or that which forms the brain and nerves, and many

others. Now, all the bones are classed by the anatomist under one head, and constitute the osseous system—the muscles constitute the muscular system—the brain, nerves, and certain tubercles in, or connected with, the nerves, called ganglia, constitute the nervous system, and so forth. Descriptive anatomy takes up each of these systems successively, and describes individually the several parts of which it consists—thus, taking up the osseous system, it describes the form, texture, foramina, connections, &c. of every individual bone in the body. General anatomy, on the other hand, neglecting the distinctive characters of particular parts, takes up likewise each system in succession, and enumerates those points which are common to the whole, or at least a large part, of each system. Again, relative anatomy, paying no regard to systems, fixes on some circumscribed region, as for example the neck, carefully analyses it, and notes the different important parts which enter into its composition, their depth from the surface, their relative positions with respect to one another, and every other particular the knowledge of which might turn to profit in operating amongst these parts in the living neck. General anatomy is especially subservient to physiology, and may be learned from books. Descriptive anatomy is subservient to medicine and surgery, and relative anatomy belongs especially to surgery. They must be learned by reading, by lectures and demonstrations, and above all, by actual dissection. Both demand the sustained attention of the student during the whole period of his education. In dissecting, habituate yourselves to examine the healthy organs with reference to the anatomy of disease. You will thus fix in your minds correct ideas of the characters of the parts in health, and be able to detect, at once, any morbid change. Anatomy viewed in this light bears

the same relation to morbid or pathological anatomy, that physiology does to the history of disease, and, notwithstanding its evident importance, is in general greatly neglected by students.

The object of physiology, is to make us acquainted with the functions of the several organs in a state of health, and as disease consists in deranged function, it is plain, we can have no idea of the derangement, without a previous knowledge of the function in health. The physiology of the stomach, for example, treats of that part of the process or function of digestion, which that organ naturally performs, and to know that it is in some way deranged in its action, necessarily implies an acquaintance with the phenomena, which constitute the healthful exercise of its office. Physiology is, perhaps, the most attractive of all the natural sciences. The interest you will take in it will be a sufficient inducement to the study of it. It abounds in theories, and the advancement of the science has been in no small degree retarded by the abuse of them. I think it of the utmost consequence, that you should enter on the study of physiology with correct notions respecting the use and abuse of theory, and the relative value of theory and fact; and that you should be cautioned against suffering yourselves to be led, by the example of most physiologists, to form a habit of loose theorising—a habit to which, unfortunately, the most intelligent and inquisitive students are most prone, and which is calculated, in the highest degree, to emasculate the mind, and unfit it for, or at least disincline it to, the investigation of facts—to the discovery of which, and to the connecting together those which are related, theory should be altogether subservient. That you may the better understand what I have to say on this subject,

and that you may have a clear idea of what is meant by a theory, I shall once more use an example. Every one knows that two great classes of animals, called warm-blooded, have the very remarkable power of sustaining in themselves a nearly uniform degree of warmth under every change of atmospheric temperature, though this is usually considerably, and often very greatly below that of their bodies. To explain the manner in which this wonderful effect is brought about, the theory of Animal Heat was invented by the celebrated Dr. Crawford—a theory the most beautiful and apparently complete ever imagined—which was some years ago universally received, and is not even yet without advocates. I shall endeavour to simplify it, so as to render it intelligible to you. The air drawn into the lungs at each inspiration contains a quantity of gas called oxygen, a part of which is found, in the expired air, to have been replaced by, or converted into, a gas of a very different kind called carbonic acid gas. In Dr. Crawford's theory, the first assumption is, that this conversion takes place in the lungs—the next, that there is such a difference between oxygen and carbonic acid gas, in relation to heat, that at any given temperature, as that of the lungs, a portion of carbonic acid gas cannot contain near the whole of the heat that entered into the composition of the oxygen from which it is formed. Thus in the conversion heat is set free, which is of course absorbed by the lungs, and especially by the large quantity of blood they contain. In every case of common combustion the very same change of oxygen into carbonic acid gas takes place, so that, according to the theory, there is, as it were, a fire constantly burning in the chest. Here then, we have a source of heat. The next difficulty regards the uniform distribution

of this heat over the body. In explanation of this, it is to be observed, that the blood undergoes a remarkable change in the lungs, by the action of the air. It enters the chest of a dark purple, and is called venous, and leaves it, to be distributed through the arteries to every part of the body, of a bright scarlet, and is called arterial blood. The theory in the next place assumes, that there is precisely the same difference in relation to heat between venous and arterial blood, that there is between carbonic acid gas and oxygen, *i. e.* that a portion of venous blood contains much less heat at a given temperature, than the arterial blood into which it is converted by the action of the air. It follows, that the temperature of the blood would fall, in the change from venous to arterial, were this not prevented, according to Crawford's last assumption, by the entrance into the arterial of the heat, at the same moment disengaged from the oxygen in its conversion into carbonic acid gas. The heat, generated in the manner we have seen, and incorporated with the arterial blood, is conveyed in it to all parts of the body by the arteries, there to be disengaged, for the maintaining of the animal heat at the moment when the blood, quitting the arteries to enter the veins, becomes once more venous. Recent and more accurate experiments than Crawford's have proved the assumptions I have mentioned to be incorrect, and the theory has of course fallen. It is sufficiently complicated to render it a matter of considerable difficulty to simplify, and at the same time to condense it in the manner I have been obliged to do; and to comprehend it fully, requires a knowledge of anatomy and chemistry, which I must suppose you not to possess. Notwithstanding these objections, I have chosen it as an example, because of its great beauty, and because, in the

use made of it by Crawford, we are presented with a model of the legitimate use of theory. This is, as I have already stated, to serve as a means for the discovery of facts, and for connecting such as are naturally related. A mere theorist would have rested indolently and confidently in his assumptions. Crawford, on the contrary, made them the occasions of multiplied and varied experiments, by which he put them to the test, and, as he supposed, established them as facts. A pardonable partiality for the offspring of his own imagination, no doubt occasioned his being too little severe in the scrutiny to which he subjected it. This, however, is a danger to which every theorist must be expected to be liable, and which justifies a certain degree of distrust of the correctness of any theory which is supported by the experiments of its author alone. As to the second part of the right use of theory, it is plain, that if Crawford's suppositions had been established as truths, his theory would have collected a great variety of physiological facts into a connected series of singular beauty. There is another sort of theory, very different from this, which deserves condemnation alone, and by which physiology is almost every where disgracefully defaced. I refer to those theories, (though, indeed, they do not merit the name) in which a word or phrase is offered as an explanation of some, perhaps complicated, process. Thus, the mysterious power by which an animal or plant generates its like, is explained by Blumenbach, one of the greatest of modern physiologists, by saying that it is the effect of the *nisus formativus*. Analyse this phrase, and it clearly amounts to this—that an animal generates by the effect of a generative effort. Again, we are told, in explanation of muscular action, that the fibres of which a muscle consists, contract by a *peculiar attraction* among

their particles, or, according to Fordyce, a distinguished physiologist, by the *attraction of life*. Dishonest theories of this sort, in which an attempt is made by their authors to impose words for knowledge, are very happily and playfully ridiculed by Fontenelle, one of the liveliest of the French philosophical writers, in his well-known essay on the "Plurality of Worlds." I think I cannot do better than translate to you the passage to which I allude, premising, that the verbal explanations of the phenomenon he speaks of, are such as were really offered, on similar occasions, by the philosophers into whose mouths he puts them. "All philosophy," says he, "is founded on these two things—that we have a great deal of curiosity, and very bad eyes. In astronomy, for example, if our *eyes* were better, we should then see distinctly, whether the stars really are, or are not, so many *suns*, illuminating worlds of their own; and if, on the other hand, we had less *curiosity*, we should then care very little about this knowledge, which would come pretty nearly to the same thing. But we wish to know *more than we see*, and there lies the difficulty. Even if we saw well the little which we do see, this would, at least, be some small knowledge gained. But we observe it *different from what it is;* and thus it happens, that a true philosopher passes his life, in not believing what he sees, and in labouring to guess what is altogether beyond his sight. I cannot help figuring to myself that nature is a great public spectacle, which resembles that of the theatre. From the place at which we sit in the theatre, we do not see the stage quite as it is. The scenes and machinery are arranged, so as to produce a pleasing effect at a distance; and the weights and pulleys, on which the different movements depend, are hid from us. We, therefore, do not trouble our heads with guessing how this

mechanical part of the performance is carried on. It is, perhaps, only some mechanician, concealed amid the crowd of the pit, who racks his brain about a flight through the air, which appears to him extraordinary, and who is seriously *bent* on discovering by what means it has been executed. This mechanic, gazing, and wondering, and tormenting himself, in the pit of the theatre, is in a situation very like that of the philosopher in the theatre of the world. But what augments the difficulty to the philosopher, is, that, in the machinery which nature presents, the cords are *completely* concealed from him—so completely, indeed, that the constant puzzle has been to guess, what that secret contrivance is, which produces the visible motions in the frame of the universe. Let us imagine all the sages collected at the theatre—the Pythagorases, Platos, Aristotles, and all those great names, which now-a-days make so much noise in our ears, Let us suppose, that they see the flight of Phaëton, as he is represented carried off by the winds; that they cannot perceive the cords to which he is attached; and that they are quite ignorant of every thing behind the scenes. It is a *secret virtue*, says one of them, that carries off Phaëton. Phaëton, says another, is composed of certain *numbers*, which cause him to ascend. A third says, Phaëton has a certain *affection* for the top of the stage. He does not feel *at his ease*, when he is not there. Phaëton, says a fourth, is not formed to fly; but he *likes better to fly than to leave the top of the stage empty*—and a hundred other absurdities of the kind, that might have ruined the reputation of antiquity, *if* the reputation of antiquity for wisdom could have been ruined. At last, come Descartes, and some other moderns, who say, Phaëton ascends, because he is drawn by cords, and because a weight, more heavy than he, is descending as

a counterpoise. Accordingly, we now no longer believe, that a body will stir, unless it be drawn or impelled by some other body, or that it will ascend, or descend, unless by the operation of some spring or counterpoise; and thus to see nature, such as it really is, is to see the back of the stage at the theatre."*

The explanation of Descartes is given in the true spirit of the Baconian philosophy. It is intelligible—sifts out the facts which have relation to the phenomenon to be explained, and by them explains it. The theories of the other philosophers (if theories they may be called) are vague and unmeaning phrases—of the same class, more or less successfully disguised by words, as the famous theory of Molière's candidate doctor, who being asked—Quare opium dormire facit? replies,

Quia est in eo
Virtus dormitiva.

Such theories are mischievous, not merely because they are nonsense, but also because they conjure up, as it were, a phantom of knowledge, which is too often taken for the reality, and prevents inquiry by misleading us to suppose we are already in possession of its fruits.—"Theories," says Dr. Brown, when speaking on this subject, in his celebrated work on the Philosophy of the Human Mind, "are of use, not as *superseding* investigation, but as *directing* investigation to certain objects—not as telling us, *what we are to believe*, but in pointing out to us *what we are to endeavour to ascertain*. A theory, in this view of it, is nothing more than a reason for making *one* experiment or observation rather than *another;* and it is evident, that, without some reason of this kind, as experiment and observations are almost infinite, inquiry

* This translation which conveys the full spirit and force of the original, is by Dr. Brown.

would be altogether profitless. To make experiments, at random, is not to *philosophise;* it becomes philosophy, only when the experiments are made *with a certain view;* and to make them, with any particular view, is to suppose the presence of something, the operation of which they will tend either to prove or disprove. When Torricelli, for example, proceeding on the observation previously made, by Galileo, with respect to the limited height to which water could be made to rise in a pump—that memorable observation, which demonstrated, at last, after so many ages of errors, what ought not for a single moment to have required to be demonstrated; the absurdity of the horror of a void ascribed to nature—when, proceeding on this memorable observation, Torricelli made his equally memorable experiment with respect to the height of the column of mercury supported in an inverted tube, and found, on comparison of their specific gravities, the columns of mercury and water to be exactly equiponderant; it is evident that he was *led* to the experiment with the mercury by the *supposition*, that the rise of fluids in *vacuo* was occasioned by some counter-pressure, exactly equal to the weight supported, and that the column of mercury, therefore, should be *less* in height than the column of water, in the exact inverse ratio of their specific gravities, *by which* the counter-pressure was to be sustained. To conceive the air, which was then universally regarded as essentially light, to be not *light* but *heavy* so as to press on the fluid beneath, was, at that time, to make as bold a *supposition* as *could* be made. It was, indeed, a temporary theory, even when it led to that experimental demonstration of the fact, which proved it for ever after not to be hypothetical."

I have dwelt on this subject at such length, because I have so often seen young men of superior talents injured

and indisposed to the acquisition of solid knowledge, their ingenuity wasted, and the vigour of their minds impaired, by an over-indulgence in theory, and misconception of its true use.

The importance of the Practice of Medicine Surgery and Midwifery, which relates to the discovering, distinguishing, treating, and predicting the issue of diseases, is so manifest, as to need no comment in our rapid review. I shall merely say, that the study of disease in the book of nature, *i. e.* at the bed-side of the patient, cannot be too strongly urged. Every student who has sufficient means, should attend an hospital during the whole course of his education. In the lectures on Medicine, Surgery and Midwifery, many books will be recommended to your attentive perusal. The lectures will present you with a digested view of the opinions of the best writers corrected by the experience of the lecturers themselves. It will be your business to compare what you learn from books and lectures, with what you see in nature; and this is an exercise in which you should be unceasingly employed.

I am particularly happy to have to announce, on this occasion, that Mr. Carmichael has again kindly consented to deliver the part of the surgical course which relates to the extensive subject of venereal diseases. His lectures on these diseases will be delivered at the Richmond Hospital, forming a part of his clinical course, and will be open to the class of this school. The questions respecting the treatment of these complicated diseases, are the most interesting and difficult which have been agitated in surgery in modern times. By the improvements in their treatment, which he has mainly contributed to introduce, he has earned a title to the lasting gratitude of his profession and of mankind. I need not

insist on the advantage you will enjoy in hearing him lecture on a subject in which he is the acknowledged leader, and on which he has concentrated a large share of his attention during a great part of his life.

A knowledge of the changes of structure, occasioned by disease, is of great importance in the treatment of it. Morbid anatomy is the science which treats of these changes. It has been cultivated of late years, especially in France, with the greatest zeal and success, and to the rapid advances it has made are to be attributed very many of the considerable improvements in practice made in our times. In addition to the considerable share of attention bestowed on this important subject in our anatomical lectures, distinct lectures will be delivered on the most important parts of it by Dr. Townsend, a gentleman who is known to have devoted himself to this branch of medical science especially, with ardour and eminent success. Never omit to be attentive observers at every examination of morbid parts, to which you can get access, taking pains, in every case, to ascertain, as far as possible, the symptoms which have preceded the changes of structure observed, and endeavouring to connect the symptoms and changes, as cause and effect.

Materia Medica and Pharmacy teach the properties of the numerous medicinal substances, as regards their influence on disease; the method of combining them, so as to produce compound remedies; and the medicinal effects of these, which are often very different from what we should have anticipated from the known action of the simpler substances of which the compound remedies consist. The treatment of disease rests immediately on Materia Medica and Pharmacy. I shall take it for granted, that this statement of their objects will sufficiently awaken your attention to their importance.

It is but recently that Medical Jurisprudence, or Forensic Medicine, has received, in these countries, that share of regard which is unquestionably its due. It embraces a variety of topics which have little in common, except that they may be made the subjects of judicial investigation. If you enter on the practice of your profession without a knowledge of it, you will run the daily risk of having your ignorance publicly exposed, and your prospects blasted—to say nothing of what is much more important, as regards the public interests, and your own peace of mind, that your ignorance may lead to the escape of the guilty from deserved punishment, or still worse, to the condemnation to death of the innocent. In some cases which fall under Medical Jurisprudence, and those the most important of which it treats, cases, for instance, of poisoning, we are called on to form our opinions, and to act, on the spur of the moment. In such cases you will have no time to seek in books for the knowledge you require, and in such cases at least, your only safety will consist in carrying an acquaintance with this science into practice. You cannot predict how soon your knowledge may be put to the test.

It remains to speak of Chemistry, Botany, Comparative Anatomy, and Natural Philosophy, which we have classed together as sciences auxiliary to the strictly medical. Of these, Chemistry is certainly the most, and in my opinion Botany is the least important. Usually, however, it is ranked next after Chemistry. It enables us to distinguish those plants which furnish the Materia Medica with its vegetable remedies, and may lead, as it often has, to the discovery of new medicines, by the application of the well-known botanical law, that plants belonging to the same natural family are likely to possess similar virtues. In another point of view, which however is

quite independent of any light derived from it to the medical sciences, Botany deserves attention. It affords, in the Linnæan classification of the vegetable kingdom, the most beautiful specimen of artificial arrangement ever devised—which it is not possible to study without acquiring such ideas of method and arrangement of thought, as must prove highly beneficial to the medical student, in arranging the multifarious knowledge with which he is obliged to store his mind.

Without pretending to accuracy of definition, it will give you some idea of the object of Chemistry, to define it to be the science which teaches us to resolve the numberless compound bodies of nature into the simple substances of which they consist, and to discover the effects of the intimate action of these on each other, and on compound bodies—and of compound bodies on one another, when brought, under certain favourable circumstances, within the sphere of mutual attraction. Chemistry is of the most extensive application in several of the medical sciences. Organic Chemistry, (that, viz. which treats of the composition, &c. of organised or living bodies) though still in its infancy, has already contributed greatly, by that part of it which relates to animal substances, to the advancement of physiology. Before the birth of pneumatic or gaseous chemistry, and the discovery of oxygen by Priestley, and of carbonic acid gas by Black, physiologists possessed almost no knowledge, worthy the name, of the vital function of respiration, or of animal heat. The use of chemistry in Materia Medica and Pharmacy, is still more extensive. The Materia Medica is indebted for very many of its remedies to chemical processes, and Pharmacy is little more than their application, under the name of Pharmaceutic Chemistry, to the procuring and com-

pounding of medicines. By the chemical action on one another of substances whose medicinal effects are known, these are in many cases modified, neutralised, or entirely changed. No remedies, therefore, should be prescribed together whose mutual influence is unknown. Otherwise, we should be constantly in danger of destroying the properties of our remedies, or of creating new ones, which may be hurtful, or even destructive, to life. For example, mercury and sulphuric acid are remedies employed in a great variety of diseases—if combined in a prescription, they would unite to form a most virulent poison. In the important article of Medical Jurisprudence, Poisoning, the detecting and nentralising of the poison depend altogether on chemistry. Enough has been said to show that this science is inferior in importance to few of the medical sciences themselves.

Comparative Anatomy teaches the structure of the animal body generally, implying further, the comparison of the structure of the body of one animal with that of another, and especially of the structure of the inferior animals with that of man. Its use to the medical student arises from its application to physiology; the ground of which I shall endeavour to explain as shortly as possible, that you may judge for yourselves what degree of importance to attach to the study of this delightful science. According to a very ancient, and not yet entirely abandoned, speculation in Natural History, the whole of nature forms a great chain of existence, of which (however dissimilar the extremes, man and brute matter, may be) the neighbouring links have the closest resemblance—establishing, as a clear consequence, the whole creation as the work of one designing mind. So far as regards the close resemblance between certain links, *i. e.* between certain species of animals, vegetables, and minerals, the

speculation is unquestionably correct. So true is this, that even the great divisions of nature into animal, vegetable, and mineral kingdoms, are by no means separated from one another by distinct and marked boundaries, and in the kingdoms themselves no decided chasms occur. In the mineral kingdom we are conducted, without abrupt change, from the most formless rock to the commencement of arrangement of parts in the diversified and beautiful forms of crystals. There is little external difference between lichens, some of the lowest plants, and the rocks on which they grow; and with regard to particular species of the lowest plants and animals, there have been long disputes concerning the kingdom to which they rightly belong. According to recent observations, which, however, require confirmation, there are even some plants (confervæ) which occasionally resolve themselves into animalcules, by the reuniting of which, the plant takes birth again, existing as if in a state of oscillation between animal and vegetable nature. Again, every species of animal, plant, and mineral, has neighbours more or less closely resembling it. In illustration of these observations, I shall compare these skulls: the human, that of the Bengal tiger, and that of the babyroussa, an animal of the hog tribe, found in some of the East India islands. I have purposely chosen them from species not nearly allied, that the resemblances we shall find to exist between them may the more strongly strike you. Any other parts of these animals, their brains, hearts, livers, &c. would have served our purpose equally well. A person quite uninformed on this subject would, perhaps, at first sight be most struck with the dissimilarity of these skulls; yet the most important difference between them consists in the heads of the tiger and babyroussa having an intermaxillary bone, which is

wanting in the human skull. On examining with some attention, we shall perceive a surprising resemblance in particulars—no real differences of form, but modifications of a type, which in most instances can be clearly connected with the habits of the animals as their final cause.

In each of the skulls you perceive a great cavity at the upper and back part in which was lodged the brain. Beneath the anterior part of this are two large empty spaces, the orbits, in which the eyes were placed. Observe, in each, a bony canal leading downwards from the orbits to open into the cavity of the nose, and another, the infra-orbitary canal, traversing its floor, and opening on the face immediately below the orbit. The bridge of the nose, formed by two oblong bones, placed side by side, and this bony arch (the zygoma) running from the side of the face to the basis of the skull, are striking features of resemblance. Behind this arch you perceive an opening, the external auditory canal, and behind, nearly in the same situation in each, a great opening by which the cavities of the skull and spine communicate, the foramen magnum, on either side of which is a smooth rounded prominence, by which the head is articulated with the first bone of the spinal column. These are a very few of the points of resemblance that might have been noticed. These other bones of the head, the lower jaw-bones, are so manifestly constructed on the same plan, that the most inattentive observer must be struck by their similarity. Each is formed of an arched portion on the upper edge of which the teeth are placed, and from either extremity of which, stands up a nearly perpendicular plate, terminated by a pointed process (the coronoid) above and before, and by a smooth rounded eminence (the condyle) above and behind. By this the

lower jaw is articulated with the skull. Lastly, we discover in the body of each bone a canal, commencing near the angle, on the inner surface, at the posterior dental foramen, and opening on the outer surface, near the chin, at the mental foramen. It is to be observed, that all these similar parts in the bones serve similar purposes in the different animals. Thus, in each, the canal leading from the orbit to the nares lodged a duct, by which the superfluous secretion of the lachrymal gland is conveyed from the eye into the nostrils, there to be evaporated, by the air passing through them, in inspiration and expiration. In the whale, an animal at the very extremity of the class to which man belongs, the pectoral fin encloses a skeleton strongly resembling that of the human arm, and especially the hand—and in this turtle, an animal not belonging to the same class with man, nor even to the next, which includes birds only, I think you cannot fail to see with surprise these rudiments of vertebræ and ribs, on the inside of the dorsal plate.

Now, reason and observation abundantly prove, that similarity of structure implies, and is accompanied by, similarity of function. Hence it is, that in physiology, we are justified in arguing, by analogy, from the condition of a function in one of the lower animals to its condition in man, and that the more nearly the structure of the animal approaches to that of man, the more confidently we may argue from analogy. Hence too, the great light that has been derived to human physiology from experiments on brutes. It is not to be denied, however, that in arguing from analogy, the utmost caution should be used. I cannot impress the necessity of this caution more strongly on your minds, than by stating the very remarkable fact, that many substances, poisonous to man, are capable of being used as food by

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other animals; and *vice versa*, that the food of man is sometimes poisonous to other animals. Thus leopard's bane (arnica montana) is fatal to man, while it is food for wild goats and swallows. Hogs feed on henbane (hyoscyamus), pheasants on stramonium, and sheep on hemlock, with impunity. Corrosive sublimate, a most virulent poison, has been considered as nearly innoxious to horses, and has been given in doses of several drachms without apparent effect. Pallas mentions, that hedgehogs in the neighbourhood of the Caspian eat hundreds of cantharides, which are highly poisonous to man, and a single one of which causes horrible torments to dogs and cats—and goats eat the cicuta virosa (water hemlock), which is famous for its destructive effects on black cattle, and is no less noxious to man. On the other hand sweet almonds kill dogs, foxes, and fowls; pepper is destructive to hogs; and parsley to the parrot. I think it reasonable to suppose, that these most remarkable differences of function have differences of structure corresponding to them; but if they exist, they are so minute as hitherto to have escaped observation. Used with the caution I have recommended, Comparative Anatomy throws great light on physiology. In every work on physiology you will find it in numberless instances applied to support or overturn particular views. "This method of reasoning in physiology," says Cuvier, in the epistle introductory to his great work on Comparative Anatomy, "can only become rigorous in proportion as we shall approach a complete knowledge of the anatomy of animals; however, if in its present state, this last science cannot yet conduct us directly to certain discoveries, it is already at least the touchstone of the results obtained by all other methods, and a single fact in Comparative Anatomy has often sufficed to destroy an entire edifice of physiological hypo-

theses"—and, I may add, that many others are principally founded on facts furnished by the same science.

The province of Natural Philosophy may be stated in a general way to be—the investigation of those attractions and repulsions between different parcels of matter which are exercised at sensible distances—of the mechanical powers—of the pressure, &c. of aeriform fluids and liquids—and of the varied and wonderful sensible motions caused by the agency of the imponderable fluids, heat, light, electricity, and magnetism. Natural Philosophy is so essential to the explanation and elucidation of a variety of physiological questions, that it is a matter of surprise to me, that some acquaintance with it is not considered indispensable to the medical student. Most physiologists, indeed, have frequently in their mouths expressions which might lead us to suppose, that they regard the living body as a sort of magic circle, within whose limits the ordinary operation of the laws of nature on matter is annulled. This view I believe to be altogether erroneous; and I am sure that it has, more than any other single error, impeded the advance of physiology. If it were not an invidious and unpleasing office, I could point out in the works of such physiologists as Bichat, Magendie, and Cuvier, names not to be mentioned without respect, considerable errors occasioned by ignorance, or at least unmindfulness, of the laws of Natural Philosophy. The truth I believe to be—that these laws are often combated or overcome in the animal body, but never annulled. The atmospheric pressure pervades all parts, reaching the marrow of the bones, and the centre of the brain, in the living body, as in the dead. When a bird mounts in the air, in spite of gravity, it does so not by annihilating, so far as regards itself, the principle of gravitation. Gravity acts on it unceasingly, and it rises by

the exercise of such powers, as, could they be put mechanically in action in a dead bird, would raise it precisely in the same manner. Again, our bodies have at this moment a temperature considerably above that of the atmosphere. Is their warmth maintained, think you, by some vital or magical influence destroying the cooling power of the cold air? Not at all. But there is set up in them a process by which sufficient heat is generated to counteract the influence of the air—*vice versa*, our bodies in air at 100° or 200° Fahr[t] would remain at about [illegible]°—not because the heat does not penetrate, and *tend* to raise their temperature, but because they set up a process of evaporation which carries off just the quantity of heat the air imparts. There are many cases besides, in which all physiologists acknowledge the influence of the laws of Natural Philosophy as having place in the living body. Thus—there is an essential part of vision which is mechanical, in which a beautiful miniature of a landscape, or other object presented to the eye, is painted on a nervous membrane at the bottom of it—and in which the lens and humours of the eye act on the rays of light, for the production of the picture, just as in the camera obscura, the lens acts in the production of a similar effect. The same may be said, mutatis mutandis, of the sense of hearing. Inspiration depends mainly upon atmospheric pressure, which plays a prominent part likewise in the circulation of the blood; and to comprehend clearly the phenomena of the circulation demands some knowledge of the laws of fluids in motion. Lastly, all physiologists agree, that the voluntary motions of the body are effected by the action of the muscles on a system of levers represented by the bones. Many other applications of Natural Philosophy to physiology I am obliged to omit. As far as regards the subjects to which I have just alluded,

it is manifest that to understand them, some knowledge of atmospheric pressure, of the laws of heat, light, sound, fluids in motion, and of the principle of levers, is absolutely necessary. Without this knowledge you cannot either comprehend, or detect mistakes in, what you read respecting them ; and in your own reasonings, you will be perpetually liable to fall into error or absurdity. It must be admitted, indeed, that the mathematical, mechanical, and chemical physiologists frequently arrived, by the misapplication of the sciences they respectively worshipped, at the most preposterous conclusions—but the true lesson their mistakes teach, is the cautious application, not the rejection, of these sciences in physiological discussions. It should be noted also, that in very many cases, where these sciences have seemed to lead to absurdity, it is the false physiology on which the chemical, mechanical, or mathematical reasoning is founded, that is alone in fault. In the application of mathematics, if they seem to lead to error, this must always be the case.

The History of the medical sciences is a subject of much interest, but for which you will not be able to spare time from the much more important subjects of which I have spoken. I shall, however, recommend a plan, by which you will be able to get considerable insight into this subject, without much expense of time or trouble. I have prepared the accompanying chart of the History of Absorption, as a specimen of what I recommend. For every subject of sufficient importance to reward the trouble, you should draw up such a chart for your own use. This one, which I shall send round, is on the plan of the celebrated Dr. Priestley's biographical chart. You will perceive, that it exhibits, at a glance, the names which have been most distinguished amongst discoverers and writers on Absorption—the periods in which they

flourished, their principal discoveries or opinions, and their dates.

The perpendicular lines in the chart indicate the centuries and half centuries written above and below them—the horizontal lines show the duration of the lives of the physiologists under whose names they are drawn. The dotted lines, before and after a few of the horizontal, signify that the date of the birth or death of the person to whose name they are attached is not known, and lastly, the perpendicular dotted lines refer to the date of the discovery of the few anatomical and physiological facts I have introduced.

A chart of this kind once framed, is a permanent record (which may be made as full as you please) of the most important facts in the subject to which it relates. In refreshing your memory on any subject already studied, such a chart would show you more, at a glance, than you could recover from books in a considerable time; and by, in a manner, localising facts and authorities, would give your memory an additional hold on them.

Most students require to be exhorted to read more than they do—but I always observe a few in every class who read too much—who aim at reading nearly all that has been written on any subject, and whose minds consequently become a perfect chaos of other men's opinions, without room for any of their own. I am no advocate for what Swift sarcastically calls "the art of being deep learned and shallow read." The precept I wish to inculcate on this point, is conveyed in the saying of another keen thinker, that "the utility of reading depends, not on the swallow, but on the digestion," and I would add on the food offered for digestion. Be select in your reading—learn from your teachers or senior fellow-students, what books really deserve an attentive perusal,

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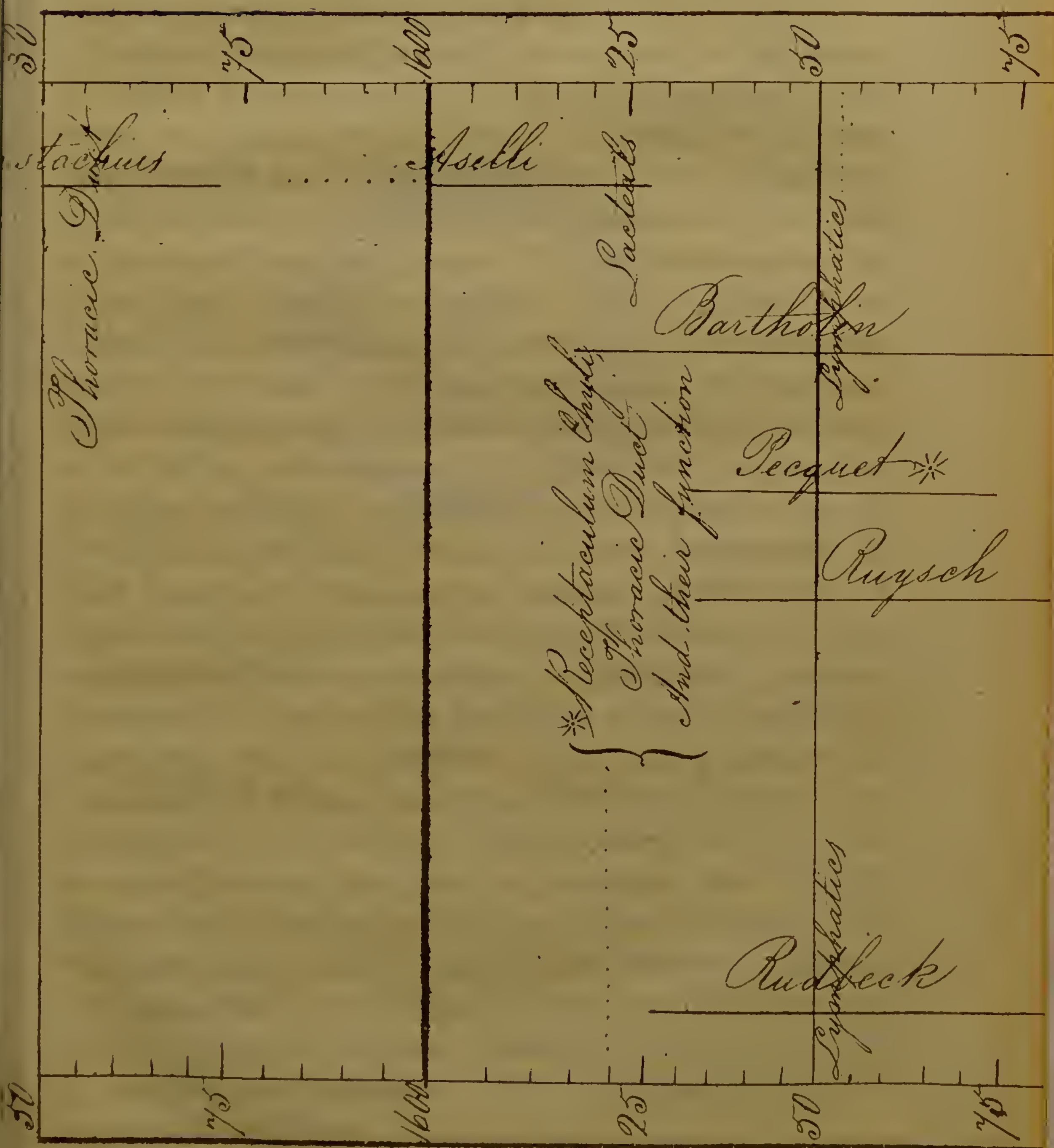

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and read nothing without reflecting on it—digesting it. You may be assured, that you would be better employed in reading books of acknowledged excellence, such as Scarpa on Aneurism, Thomson on Inflammation, Lawrence on Hernia, &c. two or three times, in short till you have mastered them, than in reading the works of inferior writers on the same subjects.

Perhaps it may be thought by some, that in the course of study I have sketched out, I have included much that might be dispensed with. To this I reply, that I have recommended no branch of knowledge from which you would not derive certain, and great assistance in the study or practice of your profession. To the direct arguments I have used already to engage you to acquire those branches of knowledge, let me add, in conclusion, this further inducement; that the respectability of our profession, and the rank it holds in society, depend, not only on its utility, and noble end—the alleviation or removal of human suffering; but also, in no small degree, on the character for learning it has at all times maintained. I think I may well use, as an inducement to the study of subjects closely connected with medical science, an argument which Blackstone thought he might fairly offer to recommend to men of our profession a study that has no connection with it whatever. "For the gentlemen of the faculty of Physic," says he, in the introduction to his celebrated Commentaries, "I must frankly own that I see no special reason why they in particular should apply themselves to the study of the law, unless in common with other gentlemen, and to complete the character of general and extensive knowledge, a character which their profession, beyond others, has remarkably deserved." Let us maintain this character. It is a legitimate object of honourable ambition.